Eu 680

INSECT SCIENCE AND ITS APPLICATION

The International Journal of Tropical Insect Science

Editor-in-Chief
Thomas R. Odhiambo
The International Centre of Insect Physiology and Ecology (ICIPE)

List of Contents, Author and Subject Index for Volume 10, 1989

ICIPE SCIENCE PRESS

Insect Science and Its Application

The International Journal of Tropical Insect Science

Sponsored by the International Centre of Insect Physiology and Ecology (ICIPE), and the African Association of Insect Scientists (AAIS)

Editor-in-Chief: **Thomas R. Odhiambo**
Associate Editor: **K. N. Saxena**
Scientific Editor: **Serah W. Mwanycky**
The International Centre of Insect Physiology and Ecology (ICIPE), P.O. Box 30772, Nairobi, Kenya

Editorial Advisory Board

F. T. Abushama, Kuwait, State of Kuwait
H. C. Agarwal, Delhi, India
J. Allen, Saskatoon, Canada
J. K. O. Ampofo, Arusha, Tanzania
A. Attygale, Ithaca, New York, USA
J. L. Auclair, Montreal, Canada
R. Galun, Jerusalem, Israel
I. Fagoonee, Reduit, Mauritius
K. M. Harris, London, U. K.
T. Hidaka, Kyoto, Japan
H. Hirumi, Nairobi, Kenya
A. G. Ibrahim, Serdang, Selangor, Malaysia
R. Kumar, Port Harcourt, Nigeria
V. M. Labeyrie, Paris, France
A. Mansingh, Kingston, Jamaica
F. G. Maxwell, College Station, Texas, U.S.A.
A. I. Mohyuddin, Rawalpindi, Pakistan
J. Mouchet, Paris, France
R. W. Mwangi, Nairobi, Kenya
L. M. Schoonhoven, Wageningen, The Netherlands
P. Singh, Auckland, New Zealand
K. Slama, Praha, Czechoslovakia
G. L. Teetes, College Station, Texas, U.S.A.
S. A. Toye, Ibadan, Nigeria
H. F. van Emden, Reading, U.K.
A. van Huis, Wageningen, The Netherlands
S. Yagi, Tsukuba, Ibaraki, Japan

PUBLISHED BIMONTHLY

Annual Subscription

For libraries, university departments, government laboratories, industrial and other multiple reader institutions (US$ 180.00; 2-year rate (1990–1991) US$ 360 (including postage and insurance), private individuals US$ 75.00; 2-year rate US$150.00. *Specially Reduced Rates for Individuals*: In the interest of maximizing the dissemination of the research results published in this important international journal we have established a two-tier price structure. Any individual whose institution takes out a library subscription may purchase a second or additional subscriptions for personal use at a much reduced rate of US$ 65.00; 2-year rate US$ 140.00. Members of the International Centre of Insect Physiology and Ecology (ICIPE) and the African Association of Insect Scientists (AAIS) may purchase a subscription at the special rate of US$ 20.00.

Application forms for membership of the AAIS (subscription US$ 20.00; 2-year rate US$ 38.00) may be obtained from: Hon. Secretary, African Association of Insect Scientists, P.O. Box 59862, Nairobi, Kenya.

Prices are subject to amendment without notice

Copyright © 1990—ICIPE Science Press, The International Centre of Insect Physiology and Ecology

It is a condition of publication that manuscripts submitted to this journal have not been published and will not be simultaneously submitted or published elsewhere. By submitting a manuscript, the authors agree that the copyright for their article is transferred to the publisher if and when the article is accepted for publication. However, assignment of copyright is not required from authors who work for organizations which do not permit such assignment. The copyright covers the exclusive rights to reproduce and distribute the article, including reprints, photographic reproductions, microform or any other reproductions of similar nature and translations. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, electrostatic, magnetic tape, mechanical photocopying, recording or otherwise, without permission in writing from the copyright holder.

Photocopying Information for users in the U.S.A.
The Item-fee Code for this publication indicates that authorization to photocopy items for internal or personal use is granted by the copyright holder for libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided the stated fee for copying beyond that permitted by Section 107 or 108 of the U.S. Copyright Law, is paid. The appropriate remittance of $3.00 per copy per article is paid directly to the Copyright Clearance Center Inc., 27 Congress Street, Salem, MA 01970.

Permission for other use
The copyright owner's consent does not extend to copying for general distribution, for promotion for creating new works or for resale. Specific written permission must be obtained from the publisher of such copying.

The item-fee for this publication is 0191–9040/90 $3.00+0.00

ICIPE SCIENCE PRESS

P. O. Box 72913, Nairobi, Kenya, East Africa

CONTENTS OF VOLUME 10

VOLUME 10 NUMBER 1

THOMAS R. ODHIAMBO	1	Preface
		Mini Review Article
B. U. SINGH and B. S. RANA	3	Varietal resistance in sorghum to spotted stem borer, *Chilo partellus* (Swinhoe)
		Research Articles
Z. H. MOHSEN and N. S. MEHDI	29	Effects of insect growth inhibitor Alsystin on *Culex quinquefasciatus* Say (Culicidae: Diptera)
KAMELIA ALY ABDEL-SALAM	35	Gamma irradiation effects on mating competitiveness of *Tribolium castaneum* (Herbst)
T. R. AHMAD	43	Pheromone concentration and plant cover types on movement of *Anarsia lineatella* (Zeller) (Lepidoptera: Gelechiidae)
D. NAMMOUR, J. AUGER et J. HUIGNARD	49	Mise en evidence de l'effet insecticide de composes soufres (disulfures et trisulfures) sur *Bruchidus atrolineatus* (Pic) (Coleoptere, Bruchidae)
TITUS K. MUKIAMA and RICHARD W. MWANGI	55	Field studies of larval *Anopheles arabiensis* Patton of Mwea Irrigation Scheme, Kenya
TAHIRA Z. MAHMOOD and M. H. QAZI	63	Density and parasitization of grasshopper egg-pods in Pakistan
AIDA M. EL-HAKIM and KAMELIA A. ABDEL-SALAM	69	Radiosensitivity of different larval stage duration pupae of the Mediterranean fruit-fly, *Ceratitis capitata* Wied.
L. CHUKA MADUBUNYI	75	Survival and productivity of the tsetse, *Glossina morsitans morsitans* Westwood (Diptera: Glossinidae) maintained under different feeding regimens, through four successive reproductive cycles in Zambia
B. S. BHUMANNAVAR, S. P. SINGH and V. V. SULLADMATH	81	Field evaluation of citrus germplasm for resistance to the black aphid, *Toxoptera aurantii* (Boy.) under tropical humid south Indian conditions
J. R. COBBINAH and J. APPIAH-KWARTENG	89	Effects of some neem products on stored maize weevil, *Sitophilus zeamais* Motsch
ALLEN M. YOUNG, BARBARA J. ERICKSON and ERIC H. ERICKSON JR.	93	Pollination biology of *Theobroma* and *Herrania* (Sterculiaceae)—III. Steam distilled floral oils of *Theobroma* species as attractants to flying insects in a Costa Rican cocoa plantation
R. T. GAHUKAR, Y. O. DOUMBIA, A. B. BAL et V. S. BHATNAGAR	99	Distribution geographique, plantes-hotes et fluctuation saisonniere des meloides au Mali et au Senegal
Software Survey Section:	*i*	
Editorial	*ii*	
Information	*iii*	
Instructions to Authors	*iv*	
Author Checklist	*vii*	

VOLUME 10 NUMBER 2

Research Articles

H. J. BARCLAY and P. VAN DEN DRIESSCHE	107	Pest control models of combinations of sterile releases and trapping
PEETER PÄTS	117	A marking technique for *Chilo partellus* (Swinhoe) (Lepidoptera: Pyralidae) by adding dye to the larval diet
T. KASU, J. A. ODEBIYI and K. M. LEMA	123	Effects of cassava pubescence on the behaviour, post-embryonic development and reproduction of the cassava mealybug, *Phenacoccus manihoti* Matile-Ferrero (Homoptera: Pseudococcidae)
ASSEFA GEBRE-AMLAK	131	Phenology and fecundity of maize stalk borer, *Busseola fusca* (Fuller) in Awassa, Southern Ethiopia
M. A. A. EID, A. N. EL-NAKKADI and M. A. SALEH	139	Functional adaptation of silk glands after administration of antibiotic to larvae of *Philosamia ricini* (Boisd)
S. R. TRIPATHI and RAJESH SINGH	145	Effect of different pulses on development, growth and reproduction of *Heliothis armigera* (Hubner) (Lepidoptera: Noctuidae)
R. K. THAPPA, K. TIKKU, BHASKAR P. SAXENA, R. M. VAID and K. K. BHUTANI	149	Conessine as a larval growth inhibitor, sterilant, and antifeedant from *Holarrhena antidysenterica* Wall
M. MANI	157	A review of the pink mealybug–*Maconellicoccus hirsutus* (Green)
G. VEERANNA and S. BASALINGAPPA	169	Nesting pattern of termites *Odontotermes obesus* Rambur and *Odontotermes wallonensis* Wasmann (Isoptera: Termitidae)
TAWFIQ M. MUSTAFA	181	Seasonal change in fat and water content in field populations of olive psylla *Euphyllura olivina* Costa (Homoptera: Psyllidae)
P. ATACHI et B. C. AHOHUENDO	187	Comparaison de quelques parametres caracteristiques de la dynamique des populations entre *Megalurothrips sjostedti* (Trybom) et *Maruca testulalis* (Geyer) sur une meme plante-hote, le niebe
G. J. STECK, G. L. TEETES and S. D. MAIGA	199	Species composition and injury to sorghum by panicle feeding bugs in Niger
M. B. KALODE and J. S. BENTUR	219	Characterization of Indian biotypes of the rice gall midge, *Orseolia oryzae* (Wood-Mason) (Diptera: Cecidomyiidae)
M. O. ODINDO, W. A. OTIENO, G. W. OLOO, J. KILORI and R. C. ODHIAMBO	225	Prevalence of microorganisms in field-sampled borers on sorghum, maize, and cowpea in Western Kenya
J. H. NDERITU and J. M. MUEKE	229	Susceptibility of eight potato cultivars to *Myzus persicae* Sulzer in the greenhouse
C. J. DEN OTTER and M. M. VAN DER HAAGEN	235	Sex pheromone attractants and inhibitors in the cabbage armyworm, *Mamestra brassicae* L. (Lep.:Noctuidae): Electrophysiological discrimination
G. W. OLOO	243	The role of local natural enemies in population dynamics of *Chilo partellus* (Swinh.) (Pyralidae) under subsistence farming systems in Kenya
Book Review	253	
Instructions to Authors	*i*	
Author Checklist	*iv*	

VOLUME 10 NUMBER 3

Research Articles

C. P. SRIVASTAVA and R. P. SRIVASTAVA — 255 Screening for resistance to gram pod borer, *Heliothis armigera* (Hubner), in chickpea (*Cicer arietinum* L.) genotypes and observations on its mechanism of resistance in India

ELLIE O. OSIR and JOHN H. LAW — 259 Purification and characterization of vitellin from the palo verde beetle, *Derobracus geminatus*

M. MUKUNTHAN — 269 Life tables of sugar-cane top borer, *Scirpophaga exerptalis* Wlk.

JOHN MACFARLANE — 277 The hemipterous insects and spiders of sorghum panicles in Northern Nigeria

J. HENDRICHS, J. REYES and M. ALUJA — 285 Behaviour of female and male Mediterranean fruit flies, *Ceratitis capitata* in and around Jackson traps placed on fruiting host trees

M. SENTHAMIZSELVAN and J. MUTHUKRISHNAN — 295 Bioenergetics of *Apanteles flavipes* Cameron (Hymenoptera: Braconidae), a parasitoid of *Porthesia scintillans* Walker (Lepidoptera: Lymantridae)

S. M. WALADDE, A. HASSANALI and S. A. OCHIENG' — 301 Taste sensilla responses to limonoids, natural insect antifeedants

MARTIN ALUJA, MARIO CABRERA, JORGE GUILLEN, HILARIO CELEDONIO and FELICIANO AYORA — 309 Behaviour of *Anastrepha ludens*, *A. obliqua* and *A. serpentina* (Diptera: Tephritidae) on a wild mango tree (*Mangifera indica*) harbouring three McPhail traps

R. K. TIWARI, K. P. SRIVASTAVA and J. N. TIWARI — 319 Role of ventral nerve cord and peripheral nerves in metamorphosis and nerve cord shortening in the lemon butterfly, *Papilio demoleus* (Lepidoptera)

P. USHA RANI and KAISER JAMIL — 327 Effect of water hyacinth leaf extract on mortality, growth and metamorphosis of certain pests of stored products

N. K. KRISHNA KUMAR, K. SRINIVASAN and H. R. SARDANA — 333 Evaluation of time of insecticidal application on the control of leafhopper, *Amrasca biguttula biguttula* Ishida (Cicadellidae: Homoptera) and aphid, *Aphis gossipii* Glover (Aphididae: Homoptera) on okra

GODWIN P. KAAYA — 341 Assessment of antibiotic potentials of insect antibacterial factors

BATTAN M. KHAEMBA — 347 Studies on the residual activity of three synthetic pyrethroids cypermethrin, fenvalerate and permethrin against cotton stainers, *Dysdercus* spp. (Hemiptera: Pyrrhocoridae)

PAULINE O. LAWRENCE — 353 Differential mortality, fecundity and egg viability of Carribean fruit fly, *Anastrepha suspensa* adults fed on three diets

B. N. SUSHEELAMMA, R. G. GEETHADEVI M. S. JOLLY JALAJA, S. KUMAR, KSHAMA GIRIDHAR, K. SENGUPTA and MEERA VARMA — 359 Effect of different mulberry varieties on silkworm, *Bombyx mori* L.

DANSOU K. KOSSOU — 365 Evaluation des differents produits du neem *Azadirachta indica* A. Juss pour le controle de *Sitophilus zeamais* Motsch sur le mais en post-récolte

P. ATACHI and B. SOUROKOU — 373 Use of Decis® and Systoate® for the control of *Maruca testulalis* (Geyer) in cowpea

MOORGESSEN PILLAY RAMSAMY 383 A survey of three main tephritids and their hosts in Mauritius and some studies on their control with attractive chemical traps

ASHOK K. SINGH and HEINZ REMBOLD 393 Oviposition behaviour of *Heliothis armigera* (Lepidoptera: Noctuidae) in relation to the day-night cycle

MUTUKU J. MUTINGA and OLUSEGUN O. DIPEOLU 401 Saurian malaria in Kenya: Description of new species of haemoproteid and haemogregarine parasites, anaplasma-like and pirhemocyton-like organisms in the blood of lizards in West Pokot District

OLUSEGUN O. DIPEOLU and MUTUKU J. MUTINGA 413 Saurian malaria in Kenya: Description of ten new species from West Pokot District

T. I. OFUYA 437 Effect of larval infestation on the choice of seed for oviposition by *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae)

Book Review 441

Publisher's Announcement 442 Publishing Reviews

Instructions to Authors *i*

Author Checklist *iv*

VOLUME 10 NUMBER 4

Research Articles

K. N. SAXENA, A. PALA OKEYO, K. V. SESHU REDDY, E. O. OMOLO and L. NGODE 443 Insect pest management and socio-economic circumstances of small-scale farmers for food crop production in Western Kenya: A case study

AYAD A. AL-TAWEEL, MOHAMMED S. H. AHMED, SARAB S. KADHUM, ASAAD A. HAMEED and MAJDOLIN J. NASSER 463 Inherited sterility in different strains of *Ephestia cautella* (Lepidoptera: Pyralidae)

U. S. SRIVASTAVA and A. K. JAISWAL 471 Precocene II-induced effects in the aphid *Aphis craccivora* Koch.

PUSHPINDER J. RUP and PARVINDER K. KALRA 477 Quantitative patterns of some hydrolytic enzymes during the development of polyphenic forms of *Lipaphis erysimi* (Kalt.) (Aphididae)

A. A. AL-TAWEEL and M. S. H. AHMED 481 Orange-eye: A new autosomal recessive mutant of *Ephestia cautella* (Lepidoptera:Pyralidae)

JOSEPH BEKAE ACKONOR 485 Laboratory studies on the effects of flood on egg development, survival and hatchling weight in *Locusta migratoria migratorioides* (Reiche and Fairmare)

P. N. KRISHNA MOORTHY and K. SRINIVASAN 491 Distribution and larval behaviour of *Lampides boeticus* in vegetable lablab

MARY J. N. OKWAKOL 497 Survival rates of human-feeding *Cubitermes testaceus* (Williams) (Isoptera: Termitidae) in relation to organic matter content

B. A. ABOU-AWAD, A. K. NASR, E. A. GOMAA and M. M. ABOU-ELELA 503 Feeding, development and reproduction of the predatory mite, *Hypoaspis vacua* on various kinds of food substances (Acari: Laelapidae)

R. RAMACHANDRAN 507 Hatching pattern and survival of first instars of *Ectropis excursaria* (Guenee) (Geometridae: Lepidoptera)

A. E. P. MNZAVA and C. F. CURTIS 513 Test for variation in flight activity between chromosome inversion types within *Anopheles gambiae (sensu stricto)*

R. NANTHAGOPAL and S. UTHAMASAMY 521 Life tables for American bollworm, *Heliothis armigera* Hubner on four species of cotton under field conditions

OLUSEGUN O. DIPEOLU and MUTUKU J. MUTINGA 531 Saurian malaria in Kenya: Redescription of some *Plasmodium* species of lizards in Africa and a key for the identification of all reported species

M. KALAYANASUNDARAM and SELLAMMAL MURUGESAN 545 Yield loss assessment and economic injury level for the leaf miner *Aproaerema modicella* (Deventer) (Lepidoptera:Gelechiidae) on soyabean in India

K. N. GHOSH and A. BHATTACHARYA 551 Laboratory colonization of *Phlebotomus argentipes* (Diptera: Psychodidae)

YEBOA A. DUODU and BENARD W. L. LAWSON 557 Reproductive behaviour of the tossa jute defoliator, *Acraea terpsicore* (L) (Lepidoptera: Nymphalidae)

Conference announcement 563

Publisher's Announcement 564 Publishing Reviews

VOLUME 10 NUMBER 5

Research Articles

C. P. SRIVASTAVA and R. P. SRIVASTAVA 565 Comparison of *Heliothis armigera* (Hubner) male moth catches in light and pheromone traps at Udaipur, Rajasthan, India

TEKLEMARIAM AYELE and MUTUKU J. MUTINGA 569 A new record of *Phlebotomus celiae* (Diptera: Phychodidae) in Ethiopia

C. GAILCE LEO JUSTIN, R. J. RABINDRA and S. JAYARAJ 573 Increased insecticide susceptibility in *Heliothis armigera* Hbn. and *Spodoptera litura* F. larvae due to *Bacillus thuringiensis* Berliner treatment

L. M. KANTIKI and J. K. O. AMPOFO 577 Larval establishment and feeding behaviour of *Eldana saccharina* Walker (Lepidoptera: Pyralidae) on maize and sorghum plants

E. BALAMANI and V. S. K. NAIR 583 Effects of anti-juvenile hormone agents and a juvenile hormone analog on neck-ligated post-feeding last instar larvae of *Spodoptera mauritia* Boisd. (Lepidoptera: Noctuidae)

OLUSEGUN O. DIPEOLU 591 Evidence of heredity in oviposition capability of ticks

K. A. ELEMO and O. AJAYI 601 Effects of nitrogen on stem borer damage in sorghum/millet mixture

J. G. WILLIAMS 607 Influence of temperature and humidity on the biology of insecticide-resistant and susceptible strains of *Tribolium castaneum* (Herbst.) (Coleoptera: Tenebrionidae)

B. A. ABOU-AWAD, A. K. NASR, E. A. GOMAA and M. M. ABOU-ELELA 617 Life history of the predatory mite, *Cydnodromella negevi* and the effect of nutrition on its biology (Acari: Phytoseiidae)

A. J. TAMHANKAR, K. K. GOTHI and G. W. RAHALKAR 625 Responsiveness of *Earias vitella* and *Earias insulana* males to their female sex pheromone

T. O. TAYO 631 Anatomical basis of cowpea resistance to the pod-borer, *Maruca testulalis* (Geyer)

JOSEPH BEKAE ACKONOR 639 Laboratory studies on the impact of drought on egg development, survival and hatchling weight in *Locusta migratoria migratorioides* (Reiche and Fairmaire)

M. BASIMIKE, MUTUKU J. MUTINGA and C. M. MUTERO 645 Vertical distribution of phlebotomine sandflies in two habitats in Marigat leishmaniases endemic focus, Baringo District, Kenya

MARY L. A. OWAGA 651 Efficiency of the biconical trap and biases in catches of female and tenerals of *Glossina pallidipes* Austen

LUCY W. IRUNGU 661 Factors influencing the development of *Brugia pahangi* microfilariae in *Culex quinquefasciatus* and *Aedes aegypti* mosquitos

M. J. MUTINGA, C. C. KAMAU J. B. KADDU, F. M. KYAI, D. M. OMOGO, J. MWANDANDU and J. NDAMBUKI 677 The biology and colonization of some Kenyan phlebotomine sandfly species (Diptera: Psychodidae)

N. VENUGOPAL RAO, A. S. REDDY, R. ANKAIAH and S. MUKUNDAN 685 Effects of whitefly, *Bemisia tabaci* Genn. on cotton yield and associated components

E. A. GOMAA, B. A. ABOU-AWAD, A. K. NASR and M. M. ABOU-ELELA 691 Life-history studies and feeding behaviour of the predatory mite, *Pachylaelaps aegyptiacus*, with description of immature stages (Acari: Pachylaelapidae)

B. M. MOHAMAD and H. F. VAN EMDEN 699 Host plant modification to insecticide susceptibility in *Myzus persicae* (Sulz.)

MADHUCHHANDA CHATTERJEE and D. K. CHAUDHURI 705 Development of *Diacrisia casignetum* Köllar (Lepidoptera: Arctiidae) on different host plants

G. A. OMOOGUN, O. O. DIPEOLU and O. A. AKINBOADE 713 Distribution and seasonal variation of tsetse population in the Egbe area of Kwara State, Nigeria

Publisher's Announcement Publishing Reviews

VOLUME 10 NUMBER 6

REVIEWS

A TEN YEAR PERSPECTIVE OF INSECT SCIENCE 1980–1989

THOMAS R. ODHIAMBO 721 Editor's Foreword

OLUSEGUN O. DIPEOLU 723 Research on ticks of livestock in Africa: Review of the trends, advances and milestones in tick biology and ecology in the decade 1980–1989

J. A. PICKETT, L. J. WADHAMS and C. M. WOODCOCK 741 Chemical ecology and pest management: Some recent insights

GODWIN P. KAAYA 751 A review of the progress made in recent years on research and understanding of immunity in insect vectors of human and animal diseases

SPECIAL SECTION

PEST MANAGEMENT AND THE AFRICAN FARMER

THOMAS R. ODHIAMBO	775	Editor's Foreword
KWESI K. PRAH and ACHOLA PALA OKEYO	777	The role of social science in generating technologies for the farming community in Africa
SANOU MOUSSA	783	Projet de formation CILSS pour le renforcement en personnel dans les activités de protection des vegetaux
ASIM A. ABDELRAHMAN and BADAR MUNIR	787	Sudanese experience in integrated pest management of cotton
G. G. M. SCHULTEN	795	The role of FAO in IPM in Africa
S. FACKNATH	809	Biological control of sugar-cane pests in Mauritius: A case study
BURKHARD SECHSER	815	New developments in pesticides for IPM in Africa with special reference to cotton pests
R. A. MOHAMAD and J. M. TERI	821	Farmers' strategies of insect pest and disease management in small-scale bean production systems in Mgeta, Tanzania
Instructions to Authors	*i*	
Author Checklist	*iv*	

SUBJECT INDEX

Acigona ignefusalis 601–605
Acraea terpsicore
  reproductive behaviour 557–562
Acrida exaltata
  egg-pod survey 65–67
actograph, acoustic 513–520
Adelphocoris apicale 281
Aedes aegypti
  Brugia pahangi in 661–675
  conessine as control 149–154
  vector immunity 753, 755, 759, 762–764
Aedes togoi 755, 762
Aedes triseriatus 757
Aedes trivittatus 759, 762
Aegyptianella elgonensis 401, 408–412
age
  distribution of *Anopheles arabiensis* 59–61
  in response to sex pheromone 625–630
  of trapped female *Glossina pallidipes* 656–675
Agrophopus 281
Aiolopus thalassinus 65–67
Alsystin
  on *Culex quinquefasciatus* 29–33
Amblyomma hebraeum 729, 733–735
Amblyomma lepidum 729
Amblyomma maculatum 591–599
Amblyomma variegatum 724–735
American bollworm *see Heliothis armigera*
Amrasca biguttula biguttula
  insecticide control 333–339
Anarsia lineatella
  pheromone bait 43–48
Anastrepha ludens 309–318
Anastrepha obliqua 309–318
Anastrepha serpentina 309–318
Anastrepha suspensa 353–357
Anopheles arabiensis 55–62
Anopheles gambiae
  flight activity 513–520
  vector immunity 756
Anopheles quadrimaculatus 755, 762
ant association of pink mealybug 163
antibiosis
  sorghum 12–14
antibiotic
  effect on silk glands 139–143
  insect potentials 341–346
antifeedant
  conessine 149–155
  limonoids 301–308
  neem products 89–92
  semiochemicals 741–748
anti-juvenile hormone agents 583–589
antixenosis—sorghum 12–14
Apanteles flavipes 295–299, 528–529
aphids *see* under specific scientific or common name
Aphis craccivora
  effects of precocene II 471–475
Aphis gossypii
  insecticide control 333–339
  integrated pest management 787–794
Aproaerema modicella
  yield loss 545–550
apterae aphids on potato 229–234
Atractomorpha acutipennis
  egg-pod survey 65–67
attacins 758–759
attractant inhibitors
  sex pheromone 235–242
attractants
  floral oils 93–98
  sex pheromone 235–242
Aulacaspis tegalensis 809–813
Azadirachta indica
  weevil control 89–92, 365–372

Bacillus cereus 753–754
Bacillus thuringiensis
  as larval treatment 573–576
  against cotton pests 815–820
  vector immunity 752, 758, 765
bean pests 821–825
Beauveria bassiana 760
Beauveria brongniartii 815–820
behaviour
  of *Anastrepha* spp. 309–318
  of *Ceratitis capitata* 285–294
  feeding, of *Eldana saccharina* 577–582
  feeding, of *Pachylaelaps aegyptiacus* 691–698
  of fruit flies 285–294
  of larval *Lampides boeticus* 491–496
  oviposition, of *Callosobruchus maculatus* 437–440
  reproduction, of *Acraea terpsicore* 557–562
Bemisia tabaci
  effect on cotton yield 685–690
  integrated pest management 787–794
benefit/cost ratio
  insecticides on cowpea 379–380
  insecticides on okra 333–339
biconical trap
  efficiency with *Glossina pallidipes* 651–659
  for *Glossina* 715–718
bioenergetics
  of *Apanteles flavipes* 295–299
biological control
  Chilo partellus 243–251
  in integrated pest management 443–462
  pink mealybug 163–164
  with semiochemicals 746–747
  of sugar-cane pests 809–813
biology
  Cydnodromella negevi 617–623
  Hypoaspis vacua 503–506
  phlebotomine sandflies 677–683
  pink mealybug 158–159
biotypes of rice gall midge 219–224
black citrus aphid
  germplasm resistance 81–88
blister beetle
  population dynamics 99–106
blood feeding
  Phlebotomus argentipes 551–555
bollworm *see Heliothis armigera*
Bombyx mori
  effect of mulberry varieties 359–363
book reviews 253, 441
Boophilus 726–728
Boophilus decoloratus 724–735
Boophilus geigyi 725–735
Boophilus microplus 731–734
Bos indicus 733–734
Bos taurus 733, 736
breeding
  for resistance in sorghum 17–20
Breinlia booliantı 755, 762
Bruchidius atrolineatus
  sulfur compound control 49–54
bruchids
  sulfur compound control 45–54
Brugia pahangi
  development in mosquitoes 661–675
  vector immunity 756, 759, 762–764
Busseola fusca
  on maize in Ethiopia 131–137
  microorganisms on 225–228
  on sorghum/millet mixture 601–605
  sorghum resistant to 11

cabbage armyworm
  pheromones 235–242
Calliphora erythrocephala 760
Callosobruchus maculatus
  effect of water hyacinth 327–332
  oviposition 437–440
Campoletis chlorideae 528–529
Campylomma angustior 277–284
Campylomma subflava 277–284
carbofuran
  control on okra 333–339
Carcelia illota 528–529
Caribbean fruit fly
  diet studies 353–357

cassava
resistance to mealybug 123–129
cassava mealybug
resistance to 123–129
cecropins 758–759
Ceratitis capitata
behaviour 285–294
gamma irradiation on 69–74
in Mauritius 383–391
cereal stem borer
microorganisms on 225–228
population dynamics 243–251
Charops aditya 528–529
Chelonis 528–529
chemical agents
with semiochemicals 744–746
chickpea
resistant genotypes 255–258
Chilo partellus
dye marking technique 117–121
microorganisms on 225–228
population dynamics 243–251
varietal resistance in sorghum 3–27
Chilo sacchariphagus 809–813
Chironomus 756
chromosomal inversion
Anopheles gambiae 513–520
Cicer arietinum
resistant genotypes 255–258
circadian rhythm
of *Anopheles gambiae* 513–520
citrus germplasm
resistance to *Toxoptera aurantii* 81–88
Citrus
host to fruit flies 285–294
resistance to *Toxoptera aurantii* 81–88
Clavigralla 281, 283
Clemora smithi 809–813
competitiveness, mating 35–42
conessine 149–155
Corchorus olitorius 557–562
Corynebacterium pseudotuberculosis 341–346
effect of water hyacinth on 327–332
Costa Rica
floral oil attractants 93–98
cotton
effects of whitefly on yield 685–690
Heliothis armigera on 521–530
integrated pest management 787–797, 815–820
cotton stainers
pyrethroids against 347–352
courtship and mating
Acraea terpsicore 557–562
cowpea
bruchid control 49–54
Callosobruchus maculatus oviposition 437–440
infestations 187–197
insecticide control 373–381
integrated pest management 443–462
resistance to pod borer 631–638
Creontiades pallidus 281
Crithia fasciculata 760–761
Crithidia 752
critical crop growth stage
for insecticide control 333–339
crop protection training 783–786
Cubitermes testaceus
survival rates 497–501
cucurbits
trapping on 383–391
Culex pipiens pipiens 753, 756
Culex quinquefasciatus
Brugia pahangi in 661–675
insect growth inhibitor on 29–33
Culex territans 755
cypermethrin
against cotton stainers 347–352
as larval treatment 573–576

Dacus cucurbitae 383–391
damage assessment
head bugs on sorghum 201–202, 205–206
day-night cycle *see also* circadian rhythm, photoperiod
oviposition behaviour 393–400
"dead hearts"
in sorghum 3–6, 8–10, 12, 15–16
Decis
on *Maruca testulalis* 373–381
deltamethrin 373–381
Dermacentor variabilis 591–599
Derobracus geminatus
vitellin analysis 258–267
development
Heliothis armigera 145–148
Hypoaspis vacua 503–506
Diacrisia casignetum 705–711
diet—Caribbean fruit fly 353–357
dimethoate 373–381
Dipetalogaster maximus 761
Dirofilaria immitis 755, 759, 762, 764
Distodieches 281
distribution
Lampides boeticus 491–496
vertical, of phlebotomine sandflies 645–650
diurnal activity
of livestock ticks 730–731
DNA, silk gland 139–143
Drosophila virilis 752
drought
impact on *Locusta* 639–643
dyes, internal 117–121
Dysdercus 281
Dysdercus fasciatus 347–352
Dysdercus koenigii 149–154
Dysdercus nigrofasciatus 347–352

Earias insulana 625–630
Earias vittella 625–630
eclosion
livestock tick 727–728
E. coli 757–759
economic injury level
for leaf miner 545–550
economic threshold level
whitefly on cotton 685–690
Ectropis excursaria instars 507–511
effective application interval 347–352
egg development
Locusta migratoria migratorioides 485–490, 639–643
egg-pod survey, grasshopper 63–68
egg structure
livestock tick 727–728
egg survival
Locusta migratoria migratorioides 485–490, 639–643
egg viability
Caribbean fruit fly 353–357
Diacrisia casignetum 705–711
Egypt
trapping fruit flies 285–294
Eichhornia crassipes
effect of leaf extract 327–332
Eldana saccharina
larval establishment and feeding 577–582
sorghum resistant to 11
taste sensilla responses 301–308
embryogenesis
livestock ticks 727–728
Empoasca lybica 787–794
encapsulation
cellular 754–755
humoral 755–757
Encarsia 815–820
endosulfan 573–576
engorgement weight
livestock tick 725–727
Enterobacter cloacae 341–346
Eperythrozoon ngokai 401, 409–412
Ephestia cautella
inherited sterility 463–469
mutant 481–483
Ephestia kuhniella 754
Eriborus argenteopilosus 528–529
esterases 477–480
Ethiopia
maize stalk borer 131–137
Phlebotomus celiae 569–571
Euphyllura olivina 181–185
Eurystylus marginatus 199–217
Eurystylus rufocunealis 277–284
Eutetranychus orientalis 617–623
exsheathment
of *Brugia pahangi* 661–675
Eyprepocnemis plorans 65–67

F_1 sterility 463–469
family farm labour 777–782
FAO—role in integrated pest management 795–807
farming systems 443–462
see also subsistence farming systems
fat content
in olive psylla 181–185
fecundity
Caribbean fruit fly 353–357
Diacrisia casignetum 705–711
Heliothis armigera 396–398
Hypoaspis vacua 503–506

irradiated *Ephestia cautella* 463–469
livestock tick 725–727
maize stalk borer 131–137
mutant *Ephestia cautella* 481–483
Tribolium castaneum 607–615
feeding regimens
Hypoaspis vacua 503–506
tsetse 75–80
feeding sites
of *Eldana saccharina* 577–582
fenvalerate
against cotton stainers 347–352
as larval treatment 573–576
fig moth 463–469, 481–483
flight activity
Anopheles gambiae 513–520
flood
effect on *Locusta migratoria migratorioides* 485–490
floral oils as attractants 93–98
flour beetle, rust-red
irradiation of 35–42
flower infestations, cowpea 187–197, 373–381
fluctuation of larval population
Maruca testulalis 373–381
food consumption
of *Apanteles flavipes* 295–299
fruit flies *see also* Caribbean fruit fly, Mediterranean fruit fly, tephritid fruit flies
behaviour 285–294
fungus comb, termite 169–179

Galleria mellonella 753–755, 762
gamma irradiation
on *Ceratitis capitata* 69–74
on *Ephestia cautella* 463–469
on *Tribolium castaneum* 35–42
generations
maize stalk borer 131–137
genetic modification
and semiochemicals 747–748
genetics
resistance in sorghum 16–17, 20
Geocoris 281
Glossina
seasonal variation 713–718
vector immunity 763
Glossina austeni 752, 761
Glossina morsitans centralis 761
Glossina morsitans morsitans
feeding regimens 75–80
immune haemolymphs 341–346
vector immunity 752–761, 763
Glossina pallidipes
trapping efficiency 651–659
vector immunity 752, 761
Glossina palpalis 752
Glossina palpalis palpalis 716–718
Glossina tachinoides 716–718
Gossypium arboreum 521–530
Gossypium barbadense 521–530
Gossypium herbaceum 521–530
Gossypium hirsutum 521–530
grain yield *see also* yield loss
cowpea 379–380
with nitrogen treatment 601–605
gram pod borer *see Heliothis armigera*
grasshopper egg-pod survey 63–68
growth
effect of water hyacinth on 327–332
Heliothis armigera 145–148
growth inhibitor
conessine 149–155

Haemaphysalis leachi leachi 725–726
haemogregarines 401–412
haemoproteids 401–412
Haemoproteus mungutii 401–404, 411
Haematractidium omogoi 401–402, 407–408, 411–412
hatching pattern
Ectropis excursaria 507–511
livestock tick 727–728
hatchling weight
Locusta migratoria migratorioides 639–643
head bugs
on sorghum 199–217
Heliothis armigera
chickpea resistance to 255–258
effect of pulse host on rearing 145–148
insecticide susceptibility 573–576
integrated pest management 787–794
life tables 521–530
oviposition 393–400
trapping 565–568
hemipterous insects
on sorghum 277–284
heredity
oviposition capability 591–599
Herrania 93–98
Heteronychus licas 807–813
Holarrhena antidysenterica 149–155
host plants
of *Diacrisia casignetum* 705–711
of fruit flies 285–294, 309–318
of pink mealybug 159–161
humidity
influence on *Tribolium castaneum* 607–615
Hyalloma 726–728
Hyalloma anatolicum anatolicum 724, 733
Hyalloma dromedarii 724, 728, 735
Hyalloma impeltatum 725
Hyalloma impressum 725
Hyalloma marginatum rufipes 724
Hyalloma silacea 729
Hyalloma truncatum 725–727, 729–730, 732
Hyalophora cecropia
immune haemolymphs 341–346
vector immunity 754, 758, 764
hydrolized protein 285–294, 309–319
Hypoaspis vacua
feeding regimens 503–506
in *Lypaphis erysimi* 477–480

immune haemolymphs
antibacterial activities 341–346
immune reactions
of insect vectors 751–769
India
biotypes of rice gall midge 219–224
chickpea resistance 255–258
citrus germplasm resistance 81–88
Lampides boeticus in lablab 491–496
leaf miner yield loss 545–550
sorghum resistance 3–27
trapping *Heliothis armigera* 565–568
inherited sterility
in *Ephestia cautella* 463–469
insect growth inhibitor
on *Culex quinquefasciatus* 29–33
insecticides
application time 333–339
sulfur compounds on bruchids 49–54
susceptibility to 573–576
integrated pest management 443–462, 741–750
of cotton 787–794, 815–820
role of FAO 795–807
intercropping 443–462
Iraq
Anarsia lineatella 43–48
Ephestia cautella 463–469
Isotima javensis 275

Jackson traps 285–294

Karyolysus poleensis 401–406, 411–412
Kenya
integrated pest management 443–462
microorganisms on borers 225–228
Mwea Rice Irrigation Scheme 55–62
phlebotomine sandflies 645–650, 677–683
saurian malarial parasites 401–412, 413–436, 531–544
Klebsiella pneumoniae 341–346
lablab
Lampides boeticus infestation 491–496
laboratory rearing
Glossina morsitans morsitans 75–80
phlebotomine sandflies 677–683
Phlebotomus argentipes 551–555
Lagenidium giganteum 755, 762
larval establishment
of *Eldana saccharina* 577–582
larval infestation and oviposition 437–440
larval stage duration
Ceratitis capitata 69–74
larval survey
Anopheles arabiensis 55–62
leafhopper
insecticide control 333–339
leaf miner
yield loss 545–550

lectins 759–762
legume pod borer
microorganisms on 225–228
Leishmania aethiopica 761
Leishmania donovani 761, 764
Leishmania hertigi 760
Leishmania hertigi hertigi 761
Leishmania major 761
leishmaniases focus
distribution of sandflies 645–650
leks
Anastrepha 309–318
fruit fly 285–294
Lepidocyrtinus incertus 504–505
Lepidosephus ulmi 505–506
Leucania loreyi 807–813
life history
Cydnodromella negevi 617–623
Pachylaelaps aegyptiacus 691–698
life tables
Heliothis armigera 521–530
Scirpophaga excerptalis 269–276
light traps
for *Heliothis armigera* 565–568
limonoids
insect antifeedants 301–308
Liorhyssus 281
Lipaphis erysimi
hydrolytic enzymes 477–480
livestock ticks 723–740
lizards—malaria parasites 401–412, 413–436, 531–544
Locusta migratoria migratorioides
effects of flood 485–490
impact of drought 639–643
longevity
Caribbean fruit fly 353–357
Heliothis armigera 398
Lygaeus 281
lysozyme 759

Maconellicoccus hirsutus
review 157–167
McPhail traps 309–318
maize
Chilo partellus on 245–251
Eldana saccharina on 577–582
integrated pest management 443–462
weevil control 89–92
maize weevil
storage control 89–92, 365–372
malathion 699–703
Mali
blister beetles 99–106
Mamestra brassicae
pheromones 235–242
Mangifera indica
trapping on 309–318, 383–391
marking technique, dye 117–121
Maruca testulalis
cowpea resistance to 631–638
insecticide control 373–381
microorganisms on 225–228
population dynamics 187–197
mass production of—*Glossina* 75–80
mating—of *Erias* 625–630
mating competitiveness
radiation effects 35–42
Mauritius
sugar-cane pests 809–813
tephritid fruit flies 383–391
mealybug, cassava 123–129
mealybug, pink 157–167
Mediterranean fruit fly
behaviour 285–294
gamma irradiation on 69–74
Megalurothrips sjostedti
population dynamics 187–197
melanization from water hyacinth 327–332
metamorphosis
anti-juvenile hormone agents 583–589
effect of water hyacinth on 327–332
in *Papilio demoleus* 319–325
precocious 471–475
microfilariae
in mosquitoes 661–675
microorganisms
on borers 225–228
midges
attracted by floral oils 93–98
rice gall midge 219–224
migration
of *Brugia pahangi* 661–675
millet
integrated pest management 803
nitrogen treatment 601–605
mites, predacious
Cydnodromella negevi 617–623
Hypoaspis vacua 503–506
Pachylaelaps aegyptiacus 691–698
models
pest control 107–116
monocrotophos
control on okra 333–339
larval treatment 573–576
mortality
of Caribbean fruit fly 353–357
effect of water hyacinth on 327–332
of *Heliothis armigera* 521–530
mulberry
effect of varieties on silkworm 359–363
Musca domestica
eggs as feed 503–506, 691–698
mustard aphid
hydrolytic enzymes 477–480
Myzus persicae
insecticide susceptibility 699–703
on potato 229–234

natural enemies
of *Chilo partellus* 243–251
of cotton pests 793
of *Heliothis armigera* 528–529
of pink mealybug 159–164
of *Scirpophaga excerptalis* 274–275
natural resistance
of livestock ticks 732–734
neem
insect control potential 89–92
on *Sitophilus zeamais* 365–372
Neoaplectana carpocapsae 755, 762, 765
nerve cord shortening
in *Papilio demoleus* 319–325
nests, termite 169–180
Niger
Eurystylus marginatus on sorghum 199–217
Nigeria
panicle feeders on sorghum 277–284
tsetse population 713–718
nitrogen level
effect on aphid 701–702
effect on stem borer 601–605
nodule formation 752–754
Nomuraea rileyi 760
Nosema 815–820
nutrition
effect on *Cydnodromella negevi* 617–623

Odontotermes obesus 169–180
Odontotermes wallonensis 169–180
okra—pest control 333–339
olive psylla
seasonal changes 181–185
Onchocerca 762
Onchocerca gutturosa 764
Onchocerca lienalis 756, 762
Onchocerca volvulus 764
Orius 277–284
Orseolia oryzae 219–224
oviposition
of *Acraea terpsicore* 557–562
of *Callosobruchus maculatus* 437–440
of *Heliothis armigera* 393–400
of ticks 591–599, 725–727
Oxya multidentata 65–67

Pachylaelaps aegyptiacus
life-history 691–698
Paecilomyces farinosus 760
Pakistan
grasshopper survey 63–68
palo verde beetle
vitellin analysis 259–267
panicle feeders
on sorghum 199–217, 277–284
Panstrongylus megistus 761
Papilio demoleus 319–325
Paramixia suturalis 277–284
parapheromones for attractive chemical traps 383–391
parasitism
on grasshoppers 63–68
on *Heliothis armigera* 528–529
on *Scirpophaga excerptalis* 274–276
parasitoids
of *Chilo partellus* 245–251
of pink mealybug 159, 161–164
of *Porthesia scintillans* 295–299
of *Scirpophaga excerptalis* 274–275
peach twig borer 43–48
peripheral nerves

in *Papilio demoleus* 319–325
Periplaneta americana 760
permethrin
against cotton stainers 347–352
pest control *see also* integrated pest management
bean production 821–825
combination models 107–116
social science interface 777–782
Pest Management and the African Farmer (proceedings) 775–825
phagocytosis 752–753
Phaleoba panteli
egg-pod survey 65–67
Phenacoccus manihoti
cassava resistance to 123–129
phenology
head bugs on sorghum 201, 203–205
maize stalk borer 131–137
pheromones *see also* parapheromones
on *Anarsia lineatella* 43–48
cabbage armyworm 235–242
of *Earias* 625–630
fruit fly 285–294
livestock tick 734
as semiochemicals 741–748
in trapping *Heliothis armigera* 565–568
as trapping techniques 107–116
Philosamia ricini 139–143
phlebotomine sandflies *see also* specific names
biology and colonization 677–683
vertical distribution 645–650
Phlebotomus argentipes 551–555
Phlebotomus celiae 569–571
Phlebotomus chinensis 764
Phlebotomus duboscqi 677–683
Phlebotomus martini 677–683
Phlebotomus mongolensis 764
Phlebotomus papatasi 761
phosphatases 477–480
photoperiod *see also* day-night cycle
in *Ectropis excursaria* 507–511
Pieris brassicae
conessine as control 149–154
vector immunity 753, 756
Pirhemocyton kongelai 401, 405, 407, 411–412
plasmodia, lizard 413–436, 542–544
Plasmodium
key of lizard plasmodia 542–544
new species 413–436
Plasmodium acuminatum 536–539, 542–544
Plasmodium adunyinkai 413, 421, 423–424, 432, 434, 543
Plasmodium bowiei 413, 428, 430–435, 544
Plasmodium cynomolgi 756
Plasmodium falciparum 756
Plasmodium fischeri 535–537, 539, 543
Plasmodium gallinaceum 753, 756
Plasmodium giganteum 540–543
Plasmodium gloriai 413, 425, 427–431, 432, 434–435, 543–544
Plasmodium icipeensis 413, 421, 424–427, 432, 434–435, 543
Plasmodium kachelibaensis 413, 419, 421–423, 434, 543
Plasmodium kadogoi 413, 418–420, 432, 434, 542
Plasmodium kaninii 413, 416–419, 432, 434, 542
Plasmodium kyaii 413, 419–422, 432, 434, 542
Plasmodium mabuiae 532–534, 539, 542
Plasmodium maculilabre 537–541, 543
Plasmodium odhiamboi 413, 430, 432–435, 544
Plasmodium ovale 756
Plasmodium pitmani 533–535, 539, 543
Plasmodium robinsoni 537–539, 543
Plasmodium sapaaensis 413, 415–417, 432, 434, 542
Plasmodium vivax 756
polyphenism
in *Lipaphis erysimi* 477–480
population dynamics
blister beetles 99–106
Chilo partellus 243–251
Maruca testulalis 187–197
Megalurothrips sjostedti 187–197
Porthesia scintillans
parasitoid on 295–299
potato
susceptibility to *Myzus persicae* 229–234
precocene II
effects on *Aphis craccivora* 471–475
predators
of *Chilo partellus* 245–251
of *Heliothis armigera* 528–529
of pink mealybug 159, 162–164
Psalydolytta fusca 99–106
Psalydolytta vestita 99–106
Pseudaletia unipuncta 752
Pterandrus rosa 383–391
pubescence
effect in plant resistance 123–129
pulses
Heliothis armigera 145–148
Pulvinaria iceyi 809–813
pupal production
Anopheles arabiensis 55–62
pupal radiosensitivity
Ceratitis capitata 69–74
Pusana regulosa 65
pyrethroids
against cotton stainers 347–352

rearing, laboratory *see* laboratory rearing
recovery resistance in sorghum 12
reproduction
Heliothis armigera 145–148
Hypoaspis vacua 503–506
reproductive behaviour
Acraea terpsicore 557–562
residual action of insecticide 347–352
resistance, insect
to insecticides 607–615
resistance, plant *see also* varietal resistance
in chickpea 255–258
in citrus 81–88
in cowpea 631–638
in integrated pest management 443–462
mechanisms in sorghum 12–14, 20
to *Myzus persicae* 699–703
Rhaconotus scirpophagae 275
Rhipicephalus appendiculatus 724
Rhipicephalus evertsi 733–734
Rhipicephalus evertsi evertsi 729–733
Rhipicephalus guilhoni 729
Rhipicephalus sanguineus 591–599, 724–726
Rhodnius prolixus 752, 754, 761
Rhyzoglyphus echinopus 503–506
rice
integrated pest management 804
rice cycle
Mwea Rice Irrigation Scheme 55–62
rice gall midge 219–224
Ricinus communis 617–623
RNA, silk gland 139–143
Romanomermis culicivorax 756
royal chamber, termite 169–179

Saccharum munja 269–275
Saccharum spontaneum 269–275
sandfly in Ethiopia 569–571
Sarcophaga peregrina 757, 759, 764
saturation deficit
Ectropis excursaria 507–511
saurian malaria parasites 401–436, 531–544
Sauroplasma kachelibaensis 401, 407–408, 410–412
Scelio 66
Schellakia mabuyai 401, 405–407, 411
Scheloribates zaheri 505–506
Schistocerca gregaria 755, 760
Scirpophaga excerptalis
life tables 269–276
Sclerostachya fusca 270–272
seasonal activities
of livestock ticks 728–730
seasonal changes
in olive psylla 181–185
seasonal variation
of tsetse populations 713–718
semiochemicals
in pest management 741–750
Senegal
blister beetles 99–106
Sergentomyia adleri 645–649, 677–683
Sergentomyia affinis 645–649
Sergentomyia africanus 645–649, 680–681
Sergentomyia antennatus 645–649, 677–683
Sergentomyia bedfordi 645–649, 677–683

Sergentomyia clydei 645–649
Sergentomyia garnhami 677–683
Sergentomyia ingrami 645–649, 677–683
Sergentomyia schwetzi 645–649, 677–683
Sergentomyia squamipleuris 645–649
Sergentomyia wynnae 680–681
Serratia marcescens 765
Sesamia calamistis
microorganisms on 225–228
sorghum resistant to 11
sugar-cane pest 809–813
sex pheromones *see* pheromones
sex ratio
of trapped *Glossina pallidipes* 657
sexual communication
in *Mamestra brassicae* 235–242
Shirakiacris kashmirensis
egg-pod survey 65
Shirakiacris shirakii
egg-pod survey 65–67
silk glands 139–143
silkworms
effect of mulberry varieties 359–363
Simulium 762
Simulium damnosum 756
Simulium ornatum 756, 762, 764
Sitophilus oryzae
effect of water hyacinth on 327–332
Sitophilus zeamais
control with neem 89–92, 365–372
small-scale farmers 443–462
see also subsistence farming systems
bean production 821–825
social science role in farm technologies 777–782
socio-economic conditions 443–462
soil organic matter
termite survival 497–501
sole crop 601–605
sooty-mould level
whitefly on cotton 685–690
sorghum
Chilo partellus 245–251
Eldana saccharina on 577–582
Eurystylus marginatus 199–217
hemipterans and spiders on 277–284
integrated pest management 443–462, 803–804
nitrogen treatment 601–605
Scirpophaga excerptalis 269–276
varietal resistance 3–27
Sorghum halepense 269–275
soyabean
leaf miner yield loss 545–550
Spathosternum prasiniferum
egg-pod survey 65–67
spiders—on sorghum 277–284
Spodoptera exigus 760
Spodoptera litura
conessine as control 149–154
insecticide susceptibility 573–576
Spodoptera mauritia
anti-juvenile hormone agents 583–589
stem borer
damage in sorghum/millet 601–605
varietal resistance in sorghum 3–27
Stenobracon deessae 275
Stenohippus 65–67
sterilants—conessine 149–155
sterile release
Ceratitis capitata 69–74
Ephestia cautella 463–469
models 107–116
Tribolium castaneum 35–42
stored food crops
blister beetle infestations 99–106
fig moth control 481–483
neem for maize weevil 89–92, 365–372
subsistence farming systems 243–251
Sudan
integrated pest management of cotton 787–794
sugar-cane pests
biological control 809–813
sugar-cane top borer
life tables 269–276
sulfur compounds
bruchid control 49–54
survival
Ectropis excursaria 507–511
livestock ticks 731–732
survival rate
Cubitermes testaceus 497–501
survivorship and curves
Anopheles arabiensis 59–61
Heliothis armigera 521–530
Scirpophaga excerptalis 274–275
susceptibility
of *Myzus persicae* 699–703
to *Myzus persicae* 229–234
of *Tribolium castaneum* 607–615
swarming, termite 169–170, 176
Systoate
for *Maruca testulalis* control 373–381

Tanzania
bean pests 821–825
taste sensilla
responses to limonoids 301–308
taxonomy
haemogregarines 401–412
haemoproteids 401–412
pirhemocytons 401–412
plasmodia 413–436, 531–544
Taylorilygus vosseleri
on sorghum 277–284
technological inputs
social science interface 777–782
Telenomus 274
temperature
in hatching *Ectropis excursaria* 507–511
influence on *Tribolium castaneum* 607–615
in rearing *Phlebotomus argentipes* 551–555
tephritid fruit flies 383–391
termites
nesting pattern 169–180
survival rates 497–501
tetracycline
effect on silk glands 139–143
tetrahydrofuran
in antifeedants 301–308
Tetranychus urticae 617–623
Theobroma
floral oil attractants 93–98
ticks
livestock 723–740
oviposition capability 591–599
tolerance
sorghum 12, 20
tossa jute defoliator
reproductive behaviour 557–562
Toxoptera aurantii
germplasm resistance to 81–88
training, crop protection 783–786
transaminases in silk glands 139–143
traps and trapping
biconical efficiency o51–659
fruit flies 285–294, 309–318, 383–391
Heliothis armigera 565–568
models 107–116
pheromone 43–48
tsetse 715–718
Triatoma infestans 753, 755, 763
Tribolium castaneum
effect of water hyacinth on 327–332
gamma irradiation on 35–42
influence of temperature and humidity 607–615
Trichogramma 528–529
Trichogramma australicum 528–529
Trichogramma chilonis 528–529
Trichogramma minutum 815–820
Trichogramma pretiosum 787–794
triflumuron 29–33
Trilophidia annulata 65–67
trimedlure
for trapping fruit flies 285–294, 383–391
Trypanosoma brucei brucei 753–754, 758, 760–761, 763
Trypanosoma brucei rhodesiense 761
Trypanosoma congolense 760–761
Trypanosoma cruzi 755, 761, 763
Trypanosoma dionesii 760
Trypanosoma rangeli 752–754
tsetse *see Glossina* species

varietal resistance—in sorghum 3–27
vector control
social science interface 777–782
vectors, insect
immunity in 751–769
vegetables
integrated pest management 803
ventral nerve cord
in *Papilio demoleus* 319–325
Vigna unguiculata see cowpea
vitellin
from palo verde beetle 259–267

water content
in olive psylla 181–185
water hyacinth
effect of leaf extract 327–332
whitefly *see Bemisia tabaci*
wing development
in *Aphis craccivora* 471–475
Wuchereria bancrofti
development in mosquitoes 661–675

Xanthopimpla predator 275

yield loss
from leaf miner 545–550
from whitefly on cotton 685–690

Zambia
Glossina feeding regimens 75–80

AUTHOR INDEX

Abdelrahman, Asim A. 787–794
Abdel-Salam, Kamelia Aly 35–42, 69–74
Abou-Awad, B. A. 503–506, 617–623, 691–698
Abou-Elela, M. M. 503–506, 617–623, 691–698
Ackonor, Joseph Bekae 485–490, 639–643
Ahmad, T. R. 43–48
Ahmed, Mohammed S. H. 463–469, 481–483
Ahohuendo, B. C. 187–197
Ajayi, O. 601–605
Akinboade, O. A. 713–718
Al-Taweel, Ayad A. 463–469, 481–483
Aluja, Martin 285–294, 309–318
Ampofo, J. K. O. 577–582
Ankaiah, R. 685–690
Appiah-Kwarteng, J. 89–92
Assefa Gebre-Amlak 131–137
Atachi, P. 187–197, 373–381
Auclair, Jacques L. 441
Auger, J. 49–54
Ayora, Feliciano 309–318

Bal, A. B. 99–106
Balamani, E. 583–589
Barclay, H. J. 107–116
Basalingappa, S. 169–180
Basimike, M. 645–650
Bentur, J. S. 219–224
Bhatnagar, V. S. 99–106
Bhattacharya, A. 551–555
Bhumannavar, B. S. 81–88
Bhutani, K. K. 149–155

Cabrera, Mario 309–318
Celedonio, Hilario 309–318
Chatterjee, Madhuchhanda 705–711
Chaudhuri, D. K. 705–711
Chaudhury, M. F. B. 253
Cobbinah, J. R. 89–92
Curtis, C. F. 513–520

Den Otter, C. J. 235–242
Dipeolu, Olusegun O. 401–412, 413–436, 531–544, 591–599, 713–718, 723–740
Doumbia, Y. O. 99–106
Duodu, Yeboa A. 557–562

Eid, M. A. A. 139–143
Elemo, K. A. 601–605
El-Hakim, Aida M. 69–74
El-Nakkadi, A. N. 139–143

Erickson, Barbara J. 93–98
Erickson, Eric H., Jr. 93–98

Facknath, S. 809–813

Gahukar, R. T. 99–106
Geethadevi, R. G. 359–363
Ghosh, K. N. 551–555
Giridhar, Kshama 359–363
Gomaa, E. A. 503–506, 617–623, 691–698
Gothi, K. K. 625–630
Guillen, Jorge 309–318

Hameed, Asaad A. 463–469
Hassanali, A. 301–308
Hendrichs, J. 285–294
Huignard, J. 49–54

Irungu, Lucy W. 661–675

Jaiswal, A. K. 471–475
Jamil, Kaiser 327–332
Jayaraj, S. 573–576
Jolly Jalaja, M. S. 359–363
Justin, C. Gailce Leo 573–576

Kaaya, Godwin P. 341–346, 751–769
Kaddu, J. B. 677–683
Kadhum, Sarab S. 463–469
Kalayanasundaram, M. 545–550
Kalode, M. B. 219–224
Kalra, Parvinder K. 477–480
Kamau, C. C. 677–683
Kantiki, L. M. 577–582
Kasu, T. 123–129
Khaemba, Battan M. 347–352
Kilori, J. 225–228
Kossou, Dansou K. 365–372
Krishna Kumar, N. K. 333–339
Krishna Moorthy, P. N. 491–496
Kumar, S. 359–363
Kyai, F. M. 677–683

Law, John H. 259–267
Lawrence, Pauline O. 353–357
Lawson, Benard W. L. 557–562
Lema, K. M. 123–129

MacFarlane, John 277–284
Madubunyi, L. Chuka 75–80
Mahmood, Tahira A. 63–68
Maiga, S. D. 199–217
Mambiri, Aggrey M. 347–352
Mani, M. 157–167
Mehdi, N. S. 29–33
Mnzava, A. E. P. 513–520

Mohamad, B. M. 699–703
Mohamed, R. A. 821–825
Mohsen, Z. H. 29–33
Moussa, Sanou 783–786
Mueke, J. M. 229–234
Mukiama, Titus K. 55–62
Mukundan, S. 685–690
Mukunthan, N. 269–276
Munir, Badar 787–794
Murugesan, Sellammal 545–550
Mustafa, Tawfiq M. 181–185
Mutero, C. M. 645–650
Muthukrishnan, J. 295–299
Mutinga, Mutuku J. 401–412, 413–436, 531–544, 569–571, 645–650, 677–683
Mwandandu, J. 677–683
Mwangi, Richard W. 55–62
Nair, V. S. K. 583–589
Nammour, D. 49–54
Nanthagopal, R. 521–530
Nasr, A. K. 503–506, 617–623, 691–698
Nasser, Majdolin J. 463–469
Ndambuki, J. 677–683
Nderitu, J. H. 229–234
Ngode, L. 443–462

Ochieng, S. A. 301–308
Odebiyi, J. A. 123–129
Odhiambo, R. C. 225–228
Odhiambo, Thomas R. 1, 721–722, 775–776
Odindo, M. O. 225–228
Ofuya, T. I. 437–440
Okwakol, Mary J. N. 497–501
Oloo, G. W. 225–228, 243–251
Omogo, D. M. 677–683
Omolo, E. O. 443–462
Omoogun, G. A. 713–718
Osir, Ellie O. 259–267
Otieno, W. A. 225–228
Owaga, Mary L. A. 651–659

Pala Okeyo, Achola 443–462, 777–782
Päts, Peeter 117–121
Pickett, J. A. 741–750
Prah, Kwesi K. 777–782

Qazi, M. H. 63–68

Rabindra, R. J. 573–576
Rahalkar, G. W. 625–630
Ramachandran, R. 507–511
Ramsamy, Moorgessen Pillay 383–391
Rana, B. S. 3–27

Reddy, A. S. 685–690
Rembold, Heinz 393–400
Reyes, J. 285–294
Rup, Pushpinder J. 477–480

Saleh, M. A. 139–143
Sardana, H. R. 333–339
Saxena, Bhaskar P. 149–155
Saxena, K. N. 443–462
Schulten, G. G. M. 795–807
Sechser, Burkhard 815–820
Sengupta, K. 359–363
Senthamizhselvan, M. 295–299
Seshu Reddy, K. V. 443–462
Singh, Ashok K. 393–400
Singh, B. U. 3–27
Singh, Rajesh 145–148
Singh, S. P. 81–88
Sourokou, B. 373–381
Srinivasan, K. 333–339, 491–496
Srivastava, C. P. 255–258, 565–568
Srivastava, K. P. 319–325
Srivastava, R. P. 255–258, 565–568
Srivastava, U. S. 471–475
Steck, G. J. 199–217
Sulladmath, V. V. 81–88
Susheelamma, B. N. 359–363
Tamhankar, A. J. 625–630
Tayo, T. O. 631–638
Teetes, G. L. 199–217
Teklemariam Ayele 569–571
Teri, J. M. 821–825
Thappa, R. K. 149–155
Tikku, K. 149–155
Tiwari, J. N. 319–325
Tiwari, R. K. 319–325
Tripathi, S. R. 145–148
Usha Rani, P. 327–332
Uthamasamy, S. 521–530

Vaid, R. M. 149–155
Van den Driessche, P. 107–116
Van der Haagen, M. M. 235–242
Van Emden, H. F. 699–703
Varma, Meera 359–363
Veeranna, G. 169–180
Venugopal Rao, N. 685–690

Wadhams, L. J. 741–750
Waladde, S. M. 301–308
Williams, J. O. 607–615
Woodcock, C. M. 741–750

Young, Allen M. 93–98

INSECT SCIENCE AND ITS APPLICATION

The International Journal of Tropical Insect Science

AIMS AND SCOPE

Insect Science and its Application deals comprehensively with all aspects of scientific research targeted on tropical insects (and related arthropods), and the application of new discoveries and innovations to such diverse fields as pest and vector management and use of insects for human welfare.

A distinctive feature of the journal is its multi- and interdisciplinary nature, which transcends the traditional boundaries of entomology.

Its second feature is its concentration on the recording and reviewing of the progress of insect science in the tropical and subtropical regions of the world. Thus, without excluding any area of the wide-ranging field encompassed by insect science, the journal will accept manuscripts in environmental physiology, the regulation of development and reproduction, population modelling, chemical ecology, natural products chemistry, plant resistance, host-insect relations, behaviour of tropical pest species, epidemiology of tropical diseases, vector biology, pest and vector management research, insect pathology, entomo-meteorology, insects in relation to farming systems, forest entomology, social insects and arthropods, and the use and farming of insects. It is the intention of the Editors to have the manuscripts published rapidly, consistent with the needs of quality control.

In addition to articles of original research, the journal also publishes mini-review articles, announcements and reports of meetings, book reviews, new patents, obituaries of prominent scientists and software survey. Each regular issue of the journal usually contains a short review article on a critical or rapidly developing area of tropical insect science; normally, the Editors will have invited an author to contribute such a mini-review.

Insect Science and its Application is an international journal, pursuing its own independent policy through its editorial staff and the Editorial Advisory Board, which is internationally appointed. Its sponsors, the ICIPE and the African Association of Insect Scientists (AAIS), do not intervene in editorial matters.

INSTRUCTIONS TO AUTHORS

For indications of the design of papers, the author should consult a recent issue of the journal. The following paragraphs are provided as guidelines for the preparation and submission of manuscripts.

1. All papers for publication in *Insect Science and its Application* should be submitted directly to Professor Thomas R. Odhiambo, Editor-in-Chief, *Insect Science and its Application,* ICIPE Science Press, P.O. Box 72913, Nairobi, Kenya. Papers should be mailed in a strong envelope, preferably linen, as they will otherwise arrive in a damaged condition.
2. Papers should be typed in English or French, and be original contributions in the field of tropical insect science. Each paper should have a summary in the form of an abstract in both English and French.
3. Submission of a paper implies that it has not been published previously, that it is not under consideration for publication elsewhere, and that if accepted for *Insect Science and its Application* the authors will transfer copyright to the ICIPE Science Press of the International Centre of Insect Physiology and Ecology. Manuscripts and illustrations become the property of the journal.
4. There is no page charge for papers accepted for publication.
5. Manuscripts and illustrations must be submitted in triplicate (original and two copies) to ensure efficient refereeing. In the case of multiple authorship, the author's should indicate who is to receive correspondence and the correct address for the mailing of proofs.
6. Manuscripts must be typewritten with double spacing (including the reference list), with wide margins, and on one side of the paper only. Authors are requested to keep their communications as concise as possible. Footnotes should be avoided, and italics should not be used for emphasis. A running head of not more than 30 letters should be

supplied.

7. The manuscript should contain the following features:

Title: This should be followed by the author's name and full address.

Abstract containing a brief summary of the contents, and conclusions of the paper. It should not be longer than 200 words, and should be supplied in both English and French.

Key Words: A short list of key words should be provided for rapid scanning of the contents of the paper and use in compiling the Index to the completed volume of the journal.

Introduction should contain a brief survey of the relevant literature and the reasons for doing the work.

Materials and Methods: Sufficient information should be given to permit repetition of the experimental work by other workers. The technical description of methods should be given only when such methods are new.

Results should be presented concisely. Only in exceptional cases will it be permissible to present the same set of results in both a table and a figure. The results section should not be used for discussion.

Discussion should be separate from the Results section, and should deal with the significance of the results and their relationship to the object of the work. Comparison with relevant published work should be made, and conclusions drawn.

Acknowledgements: Only pertinent acknowledgements should be cited.

Reference: The Harvard system will be followed. References should be detailed in the following order: Authors' names and initials, date of publication (in brackets), the title of the article, the name of the journal as abbreviated in the *World List of Scientific Periodicals* (4th edn. 1964), the volume, and the first and last pages of the article, e.g.

> Delobel A. G. L (1983) Influence of temperature and host plant condition on preimaginal development and survival in sorghum shootfly *Atherigona soccatta*. *Insect Sci. Applic.* 4, 327–335.

For books, the author's names, date of publication, title, edition, page reference, publisher's name and the place of publication should be given, e.g.

> Zurfleuh R. C. (1976) Phenylethers as insect growth regulators: laboratory and field experiments. In *Juvenile Hormones* (Edited by Gilbert L. L.), pp. 61–74. Plenum Press, New York.

Within the text, references should be given as Unnithan (1981) or (Unnithan, 1981). When a citation includes more than two authors, e.g. Ochieng', Onyango and Bungu, the paper should be referred to in the text as Ochieng' et al., provided that this is not ambiguous. If there are only two authors, they should be referred to as Ochieng' and Onyango. If papers by the same authors in the same year are cited, they should be distinguished by letters (a,b,c, etc.).

Reference to papers "in press" must mean that the article has been accepted for publication and should be given as follows:

> Darlington J. P. E. C. (1988) Primary reproductives and royal cells of the termite, *Macrotermes michaelseni*. *Insect Sci. Applic.* In press.

References to "personal communication" and unpublished work are permitted in the text only.

8. Illustrations. All necessary original illustrations should accompany the manuscript, but should not be inserted in the text. All photographs, graphs and diagrams should be numbered consecutively in arabic numerals in the order in which they are referred to in the text.

Black and white glossy photographs or positive prints (not slides or X-ray negatives) should be sent, unmounted wherever possible, and should be restricted to the minimum necessary.

Charts, graphs or diagrams should be drawn boldly in black ink on good quality white paper or card. Lettering to appear on the illustrations should be given in full and should be of sufficient size to withstand considerable reduction, where necessary. Alternatively, lettering may be shown on a rough overlay and will be inserted by the printer.

Illustrations should not be larger than 24 x 30 cm, or they may be damaged in the post. On the back of each illustration should be indicated the author's name, the figure number (in arabic numerals), and the top of the illustration, where this is not clear.

The following symbols should be used on line drawings as they are readily available to the printer: ▲ △ ▼ ▽ ■ □ × + ● ○.

Legends to figures should be typed on a separate sheet, not under the figures, and should give sufficient data to make the illustration comprehensible without reference to the text.

Magnification of photographs and illustrations should be indicated by an appropriate scale bar and not in the legend. This practice obviates the complications which arise through change of size in reproduction.

9. Tables should be constructed so as to be intelligible without reference to the text, numbered in arabic numerals, and typed on separate sheets. Every table should be provided with an explanatory caption, and each column should carry an appropriate heading. Units of measurement should always be indicated clearly. All tables and figures must be referred to in the text in numerical order.

10. Only standard abbreviations should be used. Where specialized abbreviations are used, the name should be given initially in full with the abbreviation indicated in parentheses.

11. The common and Latin names should be given for all species used in the investigation, although taxonomic affiliation and authority should not be provided in the title.

12. Page proofs will be sent to the authors by the publisher. They will already have been proof read for the printer's errors; but it is the author's responsibility to ensure that the proof contains no errors. Correction to proofs should be restricted to printer's errors only. Other than these, substantial alterations will be charged to the author. Proofs should be returned to the ICIPE Science Press within 48 hr of receipt for final preparation for the printer. Failure to meet this deadline may result in the inadvertent inclusion of errors in the published article.